CLAIMS

We claim:

1. A flexible and extensible electrode array comprising:

a flexible substrate sheet comprised of generally electrically non-conductive material; and

a plurality of electrically conductive electrodes in supporting connection with a first surface of the substrate sheet, wherein the substrate sheet includes a plurality of perforations therein, wherein the perforations enable movement of each of the electrodes relative to the substrate sheet.

2. The flexible and extensible electrode array according to claim 1, further comprising a plurality of electrically conductive traces in supporting connection with the first surface of the substrate sheet, wherein the traces extend to each electrode.

3. The flexible and extensible electrode array according to claim 2, wherein the traces are deposited on the substrate sheet.

4. The flexible and extensible electrode array according to claim 3, wherein the electrodes are deposited on the substrate sheet.

5. The flexible and extensible electrode array according to claim 1, wherein the perforations extend in generally surrounding relation of each electrode.

6. The flexible and extensible electrode array according to claim 1, wherein the substrate sheet includes at least one connection end, wherein a portion of the traces terminate on the connection end of the substrate sheet.

7. The flexible and extensible electrode array according to claim 1, further comprising an adhesive adjacent the electrodes.

8. The flexible and extensible electrode array according to claim 7, wherein the adhesive is electrically conductive.

9. The flexible and extensible electrode array according to claim 1, wherein the perforations are generally arcuate.

10. The flexible and extensible electrode array according to claim 9, wherein the perforations extend in generally surrounding relation of each electrode.

11. The flexible and extensible electrode array according to claim 10, wherein the perforations bound an electrode supporting substrate portion connected to the substrate sheet by at least one stem portion.

12. The flexible and extensible electrode array according to claim 1, wherein the traces extend on the stem portion.

13. The flexible and extensible electrode array according to claim 1, wherein the substrate sheet is transparent.

14. The flexible and extensible electrode array according to claim 1, wherein the substrate is comprised of a polyester film.

15. The flexible and extensible electrode array according to claim 4, wherein the electrodes and traces are comprised of a conductive ink.

16. The flexible and extensible electrode array according to claim 15, wherein the electrodes are comprised of a silver/silver chloride epoxy ink.

17. The flexible and extensible electrode array according to claim 16 wherein the traces are comprised of a silver epoxy ink.

18. The flexible and extensible electrode array according to claim 4 wherein the electrodes and traces are deposited on the substrate by a silk screening process.

19. The flexible and extensible electrode array according to claim 4 wherein the electrodes and trace are fabricated by chemical etching.

20. The flexible and extensible electrode array according to claim 8 wherein the adhesive includes hydrogel.

21. The flexible and extensible electrode array according to claim 20 wherein the adhesive is cured on the electrode.

22. The flexible and extensible electrode array according to claim 4, further comprising a electrically nonconductive material adjacent portions of the traces.

23. The flexible and extensible electrode array according to claim 22, wherein the electrically nonconductive material is comprised of a nonconductive ink.

24. The flexible and extensible electrode array according to claim 23, wherein the electrically nonconductive material is deposited by a silk screening process.

25. The flexible and extensible electrode array according to claim 22, where the electrically nonconductive material is a second substrate sheet

26. The flexible and extensible electrode array according to claim 25, wherein the second substrate sheet includes a plurality of apertures, wherein when the second substrate sheet is adjacent the first substrate, the apertures correspond to the positions of the electrodes.

27. The flexible and extensible electrode array according to claim 3, wherein the substrate includes a plurality of parallel perforations, whereby the parallel perforations enable the substrate to stretch in more than one direction.

28. The flexible and extensible electrode array according to claim 8, further comprising a cover sheet adjacent the substrate sheet.

29. The flexible and extensible electrode array according to claim 28, wherein the cover sheet is releasibly connected to the substrate sheet with the adhesive.

30. The flexible and extensible electrode array according to claim 4, wherein a portions of each electrode are deposited over portions of at least one trace, whereby a strong electrical connection between the electrodes and the traces is created.

31. The flexible and extensible electrode array according to claim 6, wherein the substrate sheet includes a shape that has at least one tail, wherein

the connection end is located on the tail, wherein the tail has sufficient length so as to wrap around a portion of the torso of a patient.

32. The flexible and extensible electrode array according to claim 1, wherein each electrode has the general shape of a solid circle, wherein the diameter of each electrode is about 1.27 cm.

33. The flexible and extensible electrode array according to claim 2, wherein each trace line has a width of about 0.05 cm.

33. The flexible and extensible electrode array according to claim 6, wherein the ends of the traces that terminate at the connection end include electrically conductive connection points, wherein the apparatus further includes a tail flap in operative connection with the connection end, wherein the flexible tail flap is positioned adjacent the connection points.

35. The flexible and extensible electrode array according to claim 6, wherein the tail flap is sufficiently flexible to bend away from the contact points.

36. The flexible and extensible electrode array according to claim 29, further comprising a release sheet adjacent the opposite face of the substrate sheet as the cover sheet, wherein the release sheet is in releasable adhesive connection with the substrate.

37. The flexible and extensible electrode array according to claim 36, wherein the release sheet has a plurality of rectangular apertures therethrough which form a grid pattern of rows and columns, wherein the grid pattern of rows and columns is adjacent the electrode supporting portions of the substrate sheet.

38. An electrically conductive electrode for gathering electrical signals from a body surface of a patient, comprising:

an electrically conductive, generally disc-shaped structure having a head portion;

a plurality of conical projections integral with and projecting outwardly of the head portion, wherein the conical projections include pointed tips at apexes of the conical projections, wherein the pointed tips are substantially uniformly disposed outwardly of the head portion, wherein the conical projections generally uniformly contact the body surface of the patient.

39. An electrically conductive electrode according to claim 38, wherein the disc-shaped structure further includes an integral stem orthogonal to the head portion, wherein the stem is adapted to receive a securing member for mounting the electrode and for transmitting electrical signals between the head and a remote utilization device.

40. An electrically conductive electrode according to claim 39, wherein the conical projections are nested in a circular arrangement.

41. An electrically conductive electrode according to claim 39, wherein one of the conical projections is located in the center of the head, wherein the remaining conical projections are arranged concentrically about the central conical projection.

42. An electrically conductive electrode according to claim 41, wherein a fist set of six conical projections is spaced in close relation about the central conical projection, wherein a second set of six conical projections is spaced in outward nested relation relative to the first set, wherein a third set of conical

projections is disposed outwardly relative to the second set, and wherein each of the cones in the third set are spaced in nested relation between cones in the second set.

43. An electrically conductive electrode according to claim 39, wherein the disc-shaped structure is comprised of an ABS carbon composite resin, wherein the ABS carbon composite resin includes a coating of a conductive material.

44. An electrically conductive electrode according to claim 43, wherein the coating includes a silver/silver chloride material.

45. An electrically conductive electrode according to claim 43, wherein the coating is deposited on the ABS resin material by electroplating.

46. An apparatus for collecting surface electromyographic (EMG) signals from a patient, comprising:

a plurality of electrodes, wherein each electrode includes a front side and a back side, wherein the front side includes a patient contacting surface thereon, and wherein the back side is in connection with an electrical conducting element.

a support member that is sufficiently flexible to conform to the contours of a skin surface of a patient, wherein the support member includes:

a plurality of apertures therethrough, wherein the apertures are arranged in a predetermined pattern, wherein an electrode extends in each aperture and is in releaseable supporting connection with the support member;

a front face, wherein the front face includes an adhesive thereon, wherein the adhesive has sufficient adhesive strength to adhere the support member to the skin surface of the patient and enables the support member to be removed from the skin surface of the patient with a less than harmful removal force, and wherein the front side of each electrode is positioned relative to the front face such that when the support member is adhesively adhered to the patient, the front side of each electrode contacts the skin surface of the patient.

a rear face, wherein the back side of each electrode is adjacent the rear face.

47. The apparatus according to claim 46, further comprising a plurality of flexible support discs with diameters larger than the apertures of the support member, wherein the support member includes a rear face, wherein each support disc is positioned over each aperture in releasable connection with the rear face of the support member, wherein each support discs releaseably supports at least one electrode in each aperture.

48. The apparatus according to claim 47, wherein the support discs are adhesively attached to the support member and the back side of each electrode.

49. The apparatus according to claim 47, wherein each support disc includes an opening therein, whereby electrically conducting elements can be connected to the back side of each electrode through the opening.

50. The apparatus according to claim 46, further comprising a support pad, wherein each electrode is positioned in supporting connection with the support pad in the predetermined pattern, wherein the support member includes a rear face, wherein the rear face of the support member includes a

second adhesive thereon, wherein the second adhesive is operative to adhesively connect the support pad adjacent the support member such that the electrodes are aligned with and extend in the apertures in the support member, wherein the second adhesive enables the support pad to be removed from the support member without damaging the support pad or the electrodes.

51. The apparatus according to claim 50, wherein the support pad includes a plurality of electrically conducting elements in electrical connection with each electrode.

52. The apparatus according to claim 51, wherein the support pad includes a plurality of openings therethrough, wherein the electrodes are mounted in the openings, and wherein the electrically conducting elements are in electrical connection with the electrodes through the openings.

53. The apparatus according to claim 46, further comprising an adjustable holster belt, wherein the holster belt is operative to support electrical conditioning components adjacent the patient, wherein when the support member and electrodes are in operative connection with the skin of a patient, the holster belt enables the creation of a relatively short electrical connection between the electrical conditioning components and the electrodes.

54. The apparatus according to claim 53, wherein the holster belt includes a pouch, wherein the electrical conditioning components are supported in the pouch.

55. A method for positioning an electrode array comprising the steps of:

a) placing a patient in a neutral upright position;

b) locating the fourth lumbar vertebrae of the patient;

c) marking the fourth lumbar vertebrae;

d) locating the seventh thoracic vertebrae;

e) measuring a first distance between the fourth lumbar vertebrae and the seventh thoracic vertebrae;

f) locating the left superior iliac crest at its most lateral point;

g) measuring a second distance between the most lateral aspect of the left iliac crest to the fourth lumbar vertebrae;

h) positioning an array of electrodes on the patient by aligning one of the electrodes in the electrode array over the marking of the fourth lumbar vertebrae; and

i) correlating each of the electrodes in the electrode array to the underlying anatomical structures of the patient using the measured first and second distances and the dimensions of the electrode array.

56. The method according to claim 55, further comprising prior to step (b) the step:

j) locating the positions of the left and right superior iliac crests of the patient by palpating both the left and right superior iliac crests; and

wherein in step (b) the fourth lumbar vertebrae is located by palpating the spinous process at a level where the spinous process intersects with an imaginary line between the positions of the left and right superior iliac crests.

57. The method according to claim 55, further comprising prior to step (d) the step:

j) locating the most inferior point of the inferior angles of both scapulae by palpating each scapulae; and

wherein in step (d) the seventh thoracic vertebrae is located by palpating the spinous process at a level where the spinous process intersects with an imaginary line between the most inferior points of the inferior angels of both scapulae.

58. The method according to claim 55, wherein in step (a) the feet of the patient are spaced apart with a width approximately equal to the shoulder width of the patient.

59. An electrical connector comprising:

a base member, wherein the base member includes a first surface operative to accept a connection end of a flexible electrode array adjacent the first surface;

a head member in movable connection with the base member, wherein the head member includes a second surface, wherein the head member is operative to move between a closed position and an open position, wherein in the closed position

the head member is operative to clamp the connection end between the first and second surfaces, wherein in the open position, there is sufficient space between the first and second surfaces to enable the connection end to freely move with respect to the first and second surfaces; and

a shaft member, wherein the shaft member is operative to rotate axially, wherein the shaft member includes a cam surface, wherein when the shaft member rotates the cam surface is operative to urge the head member in a direction with respect to the base such that the distance between the first and second surfaces changes.

a plurality of electrical contacts arranged in a predetermined pattern, wherein the pattern corresponds to the location of the traces on the connection end, wherein when the connection end is clamped between the first and second surfaces, each electrical contact is in electrical connection with the corresponding trace.

60. The electrical connector recited in claim 59, further comprising a printed circuit board, wherein the electrical contacts are in supporting connection with the printed circuit board.

61. The electrical connector recited in claim 60, wherein the second surface includes printed circuit board.

62. The electrical connector recited in claim 61, wherein the first surface includes a layer of foam.

63. The electrical connector recited in claim 60, wherein the first surface includes the printed circuit board.

64. The electrical connector recited in claim 59, wherein the head member includes a follower member extending in a direction opposite the second surface, wherein as the shaft member rotates, the cam surface is operative to urge the follower member in a direction that changes the distance between the first and second surfaces.

65. The electrical connector recited in claim 64, wherein the head member is biased to the closed position.

66. The electrical connector recited in claim 59, wherein the first surface includes at least one alignment pin, wherein when the connection end is placed between the first and second surfaces, the alignment pin is operative to guide the connection end to a specific position adjacent the first and second surfaces, wherein when the connection end is in the specific position, each electrical contact is aligned with one of the traces on the connection end.

67. The electrical connector recited in claim 59, wherein the electrical contacts are in operative connection with a buffer/amplifier.

68. The electrical connector recited in claim 67, further comprising a housing, wherein the buffer/amplifier and the head member are enclosed within the housing.

69. The electrical connector recited in claim 68, wherein the housing includes a slot therethrough, wherein when the connection end is inserted through the slot, the connection end slides between the first and second surfaces.

70. The electrical connector recited in claim 68, wherein the shaft member includes a lever, wherein the lever provides increased leverage for rotating the pivot member, and wherein the lever is accessible outside of the housing.

71. The electrical connector recited in claim 68, wherein the housing includes a clip, wherein the clip enables the attachment of the housing to a patient.

72. A method for connecting a flexible electrode array

a) applying an electrode array to patient, wherein the array has generally sheet like connection end with a plurality of electrically conductive traces thereon;

b) inserting the connection end into a throat area of a connector body, wherein the traces engage a plurality of electrical contacts in the throat area.

73. A method according to claim 72, further comprising the step:

c) clamping the connection end within the throat area, wherein the traces are in electrical connection with the electrical contacts.

74. A method according to claim 73, wherein each trace includes an electrical signal propagating therethrough, and further comprising the step:

d) Amplifying the electrical signal with a buffer/amplifier in electrical connection with the electrical contacts.

75. A method according to claim 72, further comprising the step:

c) lifting a connection end tail flap to expose the electrically conductive traces.